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## Weather Notes

**Editorial Note.**—Many years ago the *Monthly Weather Review* published detailed eye-witness accounts of exceptional storms. These accounts both enrich the meteorologist's knowledge of storms and provide him with particular details that cannot be found elsewhere. Because such information bears directly upon questions the meteorologist must attempt to answer about weather phenomena (for example, the identification of storms as tornadoes), and because the information has potential value in both the research and service programs of the Weather Bureau, publication of eye-witness accounts of exceptional storms and other meteorological phenomena is being resumed in this issue. These accounts will appear from time to time under the heading "Weather Notes."

### THE STORM AND TORNADOES OF MARCH 3, 1955

On March 3, 1955 thundersqualls developed to the west of Chicago and swept east-southeastward over Chicago, Ill., Gary, Westville, and on beyond Fort Wayne, Ind. At the eastern end of this path the storm struck after dark, but elsewhere the storm itself produced nearly the darkness of night, and even autoists were obliged to turn on headlights. Hall accompanied this storm over much of its path. The stones averaged nearly  $\frac{1}{4}$  inch in diameter and barely covered the ground, but in some places stones were as large as golf balls and covered the ground, and inflicted much damage. Tornadoes were observed in this storm. Damage typical of tornadoes was inflicted at various places along the path of this storm, though at some of these places no one reported seeing a funnel cloud. To be sure the terrifying nature of the storm was such as to send most potential observers to cover in basements, and the darkness may have been a factor in obscuring funnels that may have occurred.

In Chicago the main features were hail and extreme darkness, with the height of the storm at about 1515 to 1530 CST. The storm was preceded by mammatus cloud formation. During the storm strange colored casts were observable, varying from greenish purplish to orange, such as is often associated with the more violent convective storms and tornadoes. Wind was not a serious factor in Chicago. Midway Airport reported a peak gust of 38 mph, while the University of Chicago reported one gust to 42 mph. Some minor wind damages were suffered, and it is likely that at some points in the city, higher speeds were reached. A pressure jump of over 0.12 inch was recorded at Midway Airport. Lesser jumps were observed at the University of Chicago and in the Loop. The pressure profiles during the storm at the three locations were vastly different, indicating the possibility of very small local circulations. The Meteorologist at Argonne National Laboratory in Lemont reported that the pressure change there was suggestive of tornadic activity in the vicinity. A man at 2315 E. 68 St., Chicago, reported that he observed a definite funnel cloud just east of straight south from his location, estimated at 5 to 10 miles away and apparently traveling eastward. This funnel was very dark and easily seen as it was backed by a lighter, yellowish or orange background. The bottom of the funnel was obscured by buildings, so that it could not be determined if it reached the ground, but its diameter at the lowest observable point was about one-tenth only of the diameter at the point where it was attached to the general cloud base. As the location of the funnel, as described, may have been in the Lake Calumet-Wolf Lake

area, it might actually have reached the ground without being noted, as there is but little in the area that is subject to damage. It is perhaps more likely that the funnel did not reach the ground. As this funnel was observed by a man who had once experienced a severe tornado and also was seen by his wife, and as they were able to sketch and describe it so well, there is practically no doubt that it existed.

To the south of Chicago, in Park Forest, Ill., and along U. S. 30, ballstones the size of golf balls fell. Automobiles were dented and windows broken.

As the storm swept over Gary, Ind., it hit the eastern part particularly hard, especially in the Miller Beach and Ogden Dunes areas. Hail at Ogden Dunes was measured as large as  $1\frac{1}{4}$  by  $1\frac{1}{4}$  inches, with many stones averaging  $1\frac{1}{4}$  inches in diameter. Depth of stones on the ground was measured at  $2\frac{1}{4}$  inches, with drifts up to 10 inches deep. The pressure jump at the Duneland Observatory was only about 0.05 inch. Winds, however, were much stronger than recorded at Chicago, and reached a fastest mile averaging 58 mph from the northwest at 1601 CST. The five-minute maximum was 46 mph. Gusts to 60 mph were observed until the observer thought best to take refuge in the cellar. Peak gusts are conservatively estimated to have reached near 75 mph. The wind drove the hail nearly horizontally, so that many windows were broken. One house had 77 panes smashed. Greenhouses suffered serious loss. Much water damage resulted from hail and rain entering through broken windows of homes, and also much damage to roofs resulted from the wind and hail. Damage in the Ogden Dunes area was estimated at \$150,000. Many automobiles were badly dented by hail. One woman in Gary was injured when her hand was cut by falling hailstone. As the above dollar loss is for only one 2-square mile area, and as the area of severe damage was 7 miles long and  $\frac{1}{2}$  to one mile wide, total damages in the Gary-Ogden Dunes area may be in excess of  $\frac{1}{4}$  million dollars. (Revised figure is over \$1,000,000 for Lake and Porter counties alone.)

The next community to be hard hit was the Village of Westville, at the intersection of U. S. 6 and Indiana 2. Here damages of \$100,000 were suffered in an area about 5 miles long and about  $\frac{1}{2}$  mile wide. Within this area paths of severe damage were on the order of 50 to 100 feet in width, made by tornadoes which were observed by several people. The largest single loss was to a garage and contents at the mentioned intersection called West Point where a \$50,000 loss was sustained, including loss of four trucks and four automobiles. Attendants and customers were unhurt, being in the office at the time, the only part of the building remaining intact. Debris from this building could be seen for a great distance,  $\frac{1}{2}$  mile or more to the southeast, and heavy metal parts were moved considerable distances. Though the general distribution of the debris did not indicate much rotation, the roof of this building was seen to have made a nearly complete circle after the building "exploded", landing on U. S. 6, only a few hundred feet from the original site. The force of destruction and nature of the damage were definite indications of a tornado, as well as the fact that a straight wind could not have reached this building without damaging other nearby and less substantial buildings. Many trees and one shed were destroyed within two miles to the west of this garage along U. S. 6, though the major area of damage was eastward from this point, in an area about 3 miles to the east.

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## Weather Notes

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Paths of felled trees were seen on either side of U. S. 6 to the east of this intersection with most trees in an east to southeast direction. Trees were not badly twisted, though in one case adjacent trees were felled at about the most divergent directions of any observed. Some of these trees were on the property of Beatty Memorial Hospital and one fell on and damaged a house on the Hospital property.

In Westville so many trees and branches fell that the roads were impassable into or out of town and some buildings and house trailers were damaged by them. Roofs of many buildings were damaged by the wind. The tornado damaged some house trailers, one of which was entirely destroyed, save its undercarriage. The elderly occupant of this trailer was, strangely, spared from serious injury. Two others in Westville were injured by the storm; no fatalities occurred. The chimney of the school was broken by the wind. In falling through the roof, it caused an estimated \$2,000 damage. The President of the Town Board reported seeing a funnel cloud.

One mile east from town a machine shed, very substantially built, was completely destroyed and parts were hurled against the house nearby, badly damaging it. Boards entered through the house siding like pins in a cushion, and one 2 x 6 plank which had been a rafter went through a second wall after traversing a corner of the living room to enter the bedroom. The garage which had been attached to this house was also completely destroyed. Large furrows were plowed up where parts of the building hit the earth, and debris was to be seen to the southeastward  $\frac{1}{4}$  mile or more. A tornado path was observable through a woods to the eastward of this location. Damages to this one property were estimated to be in excess of \$16,000. One mile farther east a carport and machine shed which had been attached to a house were blown away and the roof of the house damaged. The lady of the house described the tornado funnel which she had seen snaking eastward across the open field to the north of the house. She said that she had just told the family that they were safe as the tornado had passed and missed them, when their home was hit with the above mentioned damage. Apparently another funnel had approached unseen.

Total estimated damages in the Westville area ran to \$100,000 or more. To summarize, the presence of tornadoes was definitely established, and it seemed almost necessary that there had been a family of small tornadoes to have caused the damages that were evident. Apart from the sightings of rotary action of debris and of funnels, and some variance of direction of tree felling, there was but little evidence of twisting action. Most trees were felled without twisting. This raises the question that it may not always be necessary to have a great amount of twisting evident in felled trees as a requisite for identifying a tornado. It is quite likely that many so called "straightline" winds in the past may actually have been tornadoes, and indeed, without careful investigation the damages at Westville might have been so attributed. The time of the storm at Westville was about 1615 to 1630 CST. The clock at the West Point Garage was stopped at 1617 CST. Hail in this area averaged about  $\frac{1}{4}$  inch, though the largest ones at West Point were reported to be nearly 2 inches in diameter.

The storm became ferocious again about 30 miles farther to the east-southeast, in the Teagarden-Lapaz area. A concrete block building located 3 miles west of Lapaz on U. S. 6, was demolished quite similarly to the garage at West Point, the explosive action suggestive of a tornado. As the building was not in use, no one witnessed its destruction. A tile-block garage and farm implement shelter on the Carl Bewley farm were badly damaged in their upper parts, typical of tornado damage. Also nearby a barn on the Roscoe Newcomb farm was lifted and partially crushed. A barn roof was demolished on the Ralph Bewley farm in this vicinity, on Tyner Rd., south of U. S. 6. Though no one reported having seen a funnel cloud, one farmer observed debris, dirt, and his wagon-bed picked up, moved, and the wagon-bed brought back again, in a violent twisting action. On the Kenneth Patterson farm on Quince Rd., one mile south of U. S. 6, roofs of the barn, two utility buildings, and the house were damaged. Press reports indicate that this occurred at shortly before 1800 CST. On the Karl Olson farm south of Donaldson a barn was struck by lightning and a cow killed. Half of a barn roof on the F. Lehman farm was demolished and two giant pine trees were snapped. The wind (tornado?) lifted the tree sections over the house with but minor damage to the house roof. A barn on the Roscoe Newcomb farm was lost as the timbers gave way; some damage was done to a car parked inside. This farm building was just east of the Lehman farm mentioned above, and on the south side of U. S. 6. Heavy damage was reported on other farms on Quince Road to the south of U. S. 6, including roofs of the house and barn on the Claude Grenet farm, and a steel granary which was blown away onto another farm. No estimate of damage was obtained, but from press reports and news pictures, it would seem that damages would surely exceed \$30,000 in the Teagarden area.

Seventy miles farther east-southeastward, in eastern Fort Wayne, Ind., another area was struck with severe damage, estimated at \$50,000. As it was dark when the storm struck, no one would have seen a funnel, and the occurrence of one is debatable from the evidence. Some evidence suggestive of such a funnel includes a 2 x 6 plank which had been picked up at a lumber yard and driven through the roof of the office building. Also, the area of damage was small, such as is often the case with such storms, being only about 500 feet wide and  $\frac{1}{4}$  mile long. Five house trailers were overturned; one rolled about 100 feet. One woman was severely injured. Four or five others were less severely injured and required no hospitalization. One home was destroyed. Several thousand dollars worth of plywood was blown around at the lumber yard and the roof of the shed housing it was damaged. The Meteorologist in Charge of the Fort Wayne Weather Bureau made an investigation to see if anyone could be found who heard or saw definite evidence of a tornado. One woman said, "It sounded awful funny." However, the overall sound of the wind and hail was such that nothing definite could be determined in that manner.

In summary, this storm which swept from Chicago to Fort Wayne left damages of ap-

proximately  $1\frac{1}{4}$  million dollars to property and livestock; no fatalities to people were reported, though 9 or 10 were injured. Hail averaged from  $\frac{1}{4}$  to  $\frac{1}{2}$  inch in most areas, but some stones up to 2 inches in diameter were seen. A tornado funnel was seen from Chicago, but no characteristic damages were noted there. Tornadoes were seen at Westville, Ind., where severe damages were inflicted, and may have occurred also at other locations in northern Indiana. This storm is notable in that, though tornadoes were definitely established to have occurred at Westville, much of the visible damage was not of the "twisted" nature that has often been thought necessary for such a storm. This suggests that many tornadoes may have occurred in the past which were not identified as such.

—R. E. Lautzenheiser, WBO, Chicago, Ill.

### TORNADOES OF MARCH 14, 1955

This is a report of an inspection by R. G. Beebe, F. C. Bates, and Paul Waite of tornado damage which occurred near Cameron and Excelsior Springs, Mo., March 14, 1955. Since numerous witnesses observed funnel clouds and heard the tornadoic roar, and the damage showed violent destruction in several places, there seemed to be no question about classifying these storms as tornadoes. In inspecting these damaged sites, and in talking to witnesses, we were especially interested in the following points: (1) Evidence of rotary motion through distribution of debris and eye-witness accounts. (2) Position of the tornado relative to the main thunderstorm cell. (3) Surface winds in the path both before and after the tornado. (4) Surface temperature change, if any. (Numerous proponents of the downdraft theory hold that the cold downdraft should result in cooling in the immediate vicinity of the funnel cloud where it reaches the ground.) (5) Time of occurrence of hail and rain relative to the tornado.

**Cameron Tornadoes.**—Two persons observed two distinct funnel clouds, but both reported that the smaller one, located just south of the large one, did not touch the ground. One witness was about  $\frac{1}{4}$  mile south of the path and 1 mile west of U. S. Highway 69, while the second person was about the same distance north of the path. The second witness observed the progress of these tornadoes from west to east. As the large tornado crossed U. S. Highway 69 ( $\frac{1}{4}$  mile south of her observation point), the smaller tornado would have been obscured from view, although the witness thought that the smaller tornado "merged with the big one." Farther along the path, several persons both observed a funnel and heard the characteristic roar.

Mr. Jack Moody observed two funnels to the northeast of him, one small and the other larger, at about 1710 CST, and neither were in contact with the ground. However, the larger one seemed to contain a lot of dust and dirt. Seconds later the larger funnel dipped to the ground, as nearly as he could ascertain, just west-southwest of the buildings on the A. D. Walker farm. Some damage was noted along a fence at this point. Some 200 yards downstream (northeast) a granary on the Walker farm was badly damaged, and the debris scattered to the east-northeast for about 300 yards and directly along the tornado path as evidenced by broken tree limbs. No debris was noted to the north or south of the path. The Walker house, located some 50 yards to the southeast of the granary, was not damaged except that a brick chimney was blown off toward the north-northeast. Since a TV antenna was anchored to this chimney, this damage would seem to have resulted from strong wind. Three persons were in the house at the time and heard no roar. They observed no funnel, but did see whirling debris and dirt in the air north of the house at the time.

Some scattered slight damage to trees occurred over the path for about the next mile. Two sheds on the W. E. Middaugh farm (east-northeast of the Walker farm) were completely demolished, and debris, including boards and sections of the roof, were thrown to the north and north-northwest (left of the path) as much as 200 yards. About  $\frac{1}{4}$  mile down the path, considerable damage was done to other buildings including the residence of the Middaugh farm. At this point, Osage orange trees, some 200 yards south of the apparent track, were badly damaged. Also, south of the track, weeds were blown against a woven wire fence (along a north-south line) from the west. The fence was packed with weeds and straw to a depth of about 6 inches and a height of 3 feet southward from the farm buildings to the Osage orange trees. Two trees on the northeast and southeast corners of the house had large branches broken off toward the south. Several windows in the house were shattered with the glass outside.

The path continued across the road (U. S. 69), evidently on an easterly course now, with scattered damage to trees. Considerable damage occurred on the Chester G. Curtis farm to buildings and trees. While a barn was badly damaged and large trees near the house were blown over, the house appeared untouched—all windows were intact. All debris seemed to be along a narrow (50-yard) path toward the east. Many orchard trees were blown over from the west or southwest. Mr. Curtis heard the roar while inside the barn which was badly damaged. Although 5 sheep were killed in this barn, Mr. Curtis escaped injury.

At the W. H. Potter farm (immediately to the southeast of the Curtis farm on south side of Missouri 121) large trees north of the house were blown eastward, the house was undamaged, and the major damage occurred to a garage just south of the house. A car inside the garage was overturned and badly damaged. Debris was thrown eastward.

At the Leonard Jones farm directly eastward from Potter's a small house was moved about 30 feet toward the southeast. Several small buildings were demolished and debris was scattered toward the east. A small fenced (woven wire) field just east of the buildings showed a packing of straw and weeds from the west along the north-south fence and a packing of weeds and straw from the north along the east-west fence. The only injury caused by the two tornadoes was to Mrs. Lois Jones, who was in a trailer home in their farm yard as it was overturned. Mrs. Jones suffered shock, bruises and abrasions.

Mrs. Harry Sockman (also Mr. Medille Sockman) observed the funnel approaching from the west and telephoned her daughter who lives about  $\frac{1}{4}$  mile west of her and about 1 mile southeast of the Jones farm. The daughter then saw the funnel approaching, also heard the roar, and went to the storm cellar. She described the funnel as exactly funnel-shaped and extending upwards "high into the sky." A shed, some 30 yards away from the house, was demolished, along with other minor damage, but there was no damage to the house. All debris was strewn to the east.

The buildings of the Steve Tully farm to the east-southeast, suffered severe damage. Several windows on the south were blown outward, and a lamp table was thrown into the yard. Most of the debris was thrown eastward, but with some debris 50 yards to the north (left) of the apparent path. Bessie Tulley left Cameron in a "heavy rainstorm," drove south on U. S. 69 until she saw the two funnels near the intersection of this highway with Missouri 121 (near the Middaugh farm). Here she waited until the two tornadoes moved eastward across the highway (69) and then she could see only one tornado. A little later (she could not estimate the time) she drove on to her farm some five miles to the east. She estimated that they drove 40 m. p. h. but, even so, the tornado remained well ahead of the car.

Additional damage was reported farther eastward by persons who were interviewed and these include reports of tornado occurrences near Kingston, Mooreville, and Chillicothe. If those were tornadoes, the path of the main tornado south of Cameron might have continued to these other localities.

Interviews and observations in connection with these storms brought out the following interesting points: (1) Two funnels were observed but only one track was noted and only one tornado was observed to reach the ground and cause damage. (2) The roar was heard by several persons. (3) A whirling motion of dust and debris was noted by several persons. (4) Evidence of rotary motion in damage or debris was noted at only the following three locations: a. Debris from a shed on the Middaugh farm was thrown up to 200 yards north and west of the original location while the tornado was following a track from about  $240^\circ$ ; b. Two trees near the Middaugh farm were broken off toward the south; c. Debris on the fence of the Jones farm indicated a strong westerly wind along a north-south fence which covered an east-west fence along which debris was driven in from the north. (5) With these three exceptions all debris, broken trees, and branches indicated a strong westerly wind. (6) The path width was never wider than 250 yards and generally less. The length investigated was about 6 miles and perhaps was as much as 30 miles. Some "skipping" was noted throughout the length, although some of this could be a consequence of a track over open fields. (7) All witnesses stated that the main thunderstorm cell was to the north where rainfall amounts were generally given as 1 inch or more, starting about 2 or 3 miles north of the tornado track. One witness, who was perhaps in the best position of any, stated that the two tornado funnels were near the southwest quadrant of the thunderstorm cell. (8) No rain or hail preceded the tornado. Light rain ("settled the dust"; "less than a quarter inch," etc.) followed the tornado by about 10 minutes. Some hail ranging in size from  $\frac{3}{4}$ " to  $1\frac{1}{4}$ " followed the tornado by about 10 minutes. (9) All observers gave the time as either "around 5 o'clock" or 5:10 p. m. (10) Witnesses could not state definitely whether or not the funnels were attached to a cloud. (11) Thunderstorms preceded and followed the tornado. (12) All persons described the afternoon as "windy" but said that before and immediately after the tornado, the wind was light from the south or southwest. (13) Persons who saw the funnels or observed rotary motion could not describe the direction of rotation. (14) All persons who were in the vicinity of the funnel itself stated that they observed no noticeable temperature change as the tornado passed by.

[Editor's note:—In addition to the above we have received two eye-witness accounts which follow. The first observer located the storm as 4 miles south of Cameron at Clinton School and thence eastward. He was located about  $2\frac{1}{2}$  miles north of the storm and about 1 mile east. He reported seeing funnel at 1710 CST hanging from the cloud base and touching the ground. Hail of  $\frac{1}{2}$  to 2 inches in diameter fell over a "large area"

during the storm. Largest hailstones were observed before the storm's passage and to the left of its subsequent path. Excessive rain (1.1 inches in 10 min.) fell before and during the period of most intense winds and to the left of the path of maximum wind intensity. This observer reported no excessive lightning or thunder, but heard an unusual, loud noise before and during the storm's passage but after the heaviest rain when the storm had moved to the east. It sounded like "hail on farm buildings farther east though it was louder and more intense."

[The second observer reported the storm location as 8 miles southwest of Hamilton which is directly east of Cameron. At about 1700 CST he saw a funnel extending from the cloud base and touching the ground. It moved from west to east and had a counterclockwise rotation. The pattern of debris was also counterclockwise. Hailstones three-fourths of an inch in diameter, fell over an area he estimated as 6400 square miles during the passage of the storm. The hailstones were largest after passage and to the left of the path. He estimated that two inches of rain fell in one hour, the heaviest period of rain being after the most intense winds and to the left of the path of maximum wind. This observer reported no unusual lightning but unusually loud and frequent thunder. No other unusual noises accompanied the storm. Both observers reported observing the storm until 1730 CST.]

**Excelsior Springs Tornadoes.**—The storm damage in and near Excelsior Springs evidently resulted from two tornadoes and possibly a third. The first occurred east of town and damaged five farm buildings along the County Line Road. One person who was interviewed observed the funnel and heard the characteristic roar at 1740 CST. Several barns and sheds were demolished and the debris lay in a straight line, apparently along the path. However, these sites were not investigated in detail. Also, there were reports of damage as far east as Rayville, 9 miles to the east.

The second, and most destructive tornado, struck in the center of Excelsior Springs at 1800 CST. The principal damage was to the Lambert Lumber Yard where the roof (160 feet long) was blown off and debris scattered to the south. Large pieces from this roof were carried two blocks away and over a 2-story school building. Some 35 windows of a motel across the street were damaged by flying debris. Two cars and a dump-truck, parked on the west side of the lumber yard, were overturned and badly damaged. A 2 x 6 plank, about 10 feet long, was rammed through the dual tires on the rear of the truck. After the storm, the truck was on its side with about 8 feet of the 2 x 6 extending vertically upward.

While the lumber yard was located near the center of the city, no other damage of consequence was noted except a plate glass window in a filling station was exploded outward and one stop sign was twisted off. Mr. Walter Armstrong, manager of the Lambert Lumber Yard, heard the roar which he identified as a characteristic of tornadoes (he had heard this roar on two previous occasions). One filling station attendant, near the lumber yard, was reported to have observed the funnel itself. Light rain fell in the vicinity during the tornado and several persons reported that the dark thunderstorm clouds were to the north. Hail, diameter up to three-fourths of an inch, fell about 15 minutes after the tornado occurrence.

Another (possibly the same one as described above) storm occurred about 2 miles southwest of town around 1800 CST. This path was short and horseshoe-shaped, and the storm moved to the southeast. A garage and barn were smashed. There were no reports of a funnel or roar in this area; the information here was given by Marvin Crowley, a reporter for *The Daily Standard*.

Severe Local Storms forecast No. 50 was issued at 1210 CST this date and was as follows: ". . . most intense area along and 50 either side line from 30 west Topeka to Ottumwa, Iowa, with scattered tornadoes expected this area from 1400C to 2200C. . . ." This forecast was known to most of the persons interviewed and several expressed their appreciation of the Weather Bureau's "twister forecasts." Protective measures were generally to keep watching for unusually dark thunderstorms or funnel clouds and take cover after the funnel was sighted.—Robert G. Beebe, SELS Center, WBAS, Kansas City, Mo.

## CORRECTION

MONTHLY WEATHER REVIEW, vol. 83, No. 3: In table of contents on front cover, author of "The Weather and Circulation of March 1955" is Jay S. Winston.